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B. T. GALLOWAY, Chief of Bureau.

THE CONTROL OF COTTON WILT AND ROOT-KNOT.

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THE CONTROL OF COTTON WILT AND ROOT-KNOT.

INTRODUCTION.

General attention should be called to the spread of two diseases which seriously injure cotton, particularly on sandy land. These are cotton wilt, or "black-root," and root-knot. They already occur in scattered localities from North Carolina to Texas and are estimated to cause an annual loss exceeding $10,000,000. There are thousands of acres of land already so infested that ordinary varieties of cotton can not be grown, and the area enlarges each year.

In addition to the loss of crops this land has depreciated in market value; it costs more to cultivate on account of the weeds and grass that spring up after the cotton dies, and the farmer must often use it for crops less profitable than cotton.

This situation is the more unfortunate because it is unnecessary. These diseases may be controlled by the means pointed out in this circular.

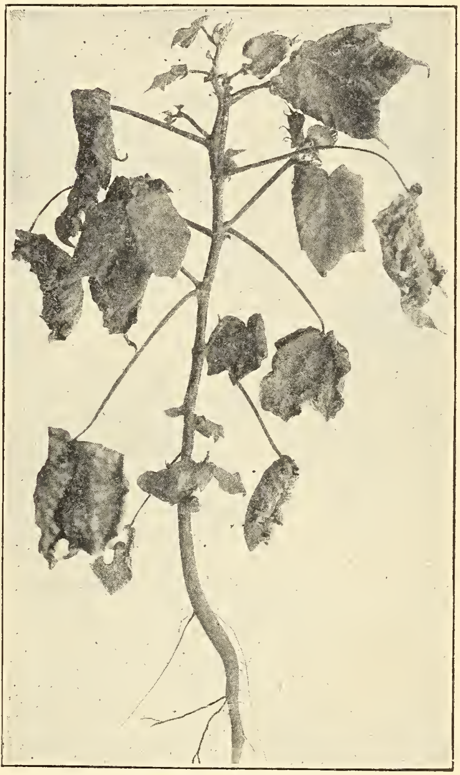

FIG. 1.—A young cotton plant dying from wilt.

HOW TO RECOGNIZE COTTON WILT.

When plants wilt suddenly or the leaves yellow and fall without apparent reason, the wilt is to be suspected. (Fig. 1.) If a freshly wilted plant is pulled and the inner wood of the stem or root is found blackened (fig. 2), the disease is almost certainly wilt.

The trouble begins in May and June and continues to develop throughout the season. Its first appearance in a field is likely to be in small spots, which enlarge each season until considerable areas are affected. Beyond the places where the cotton is killed, dwarfed or stunted plants occur. Some plants remain alive in the worst areas, and by selection from such individuals resistant varieties have been developed.

Cotton wilt is more fully described in Farmers' Bulletin 333, entitled "Cotton Wilt," which will be sent free upon application to a Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture.

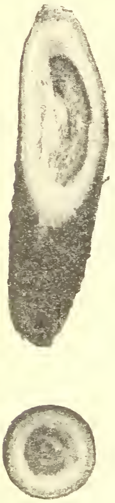

Fig. 2.—Cross sections of cotton stem, showing browning of wood caused by the wilt fungus. (Natural size.)

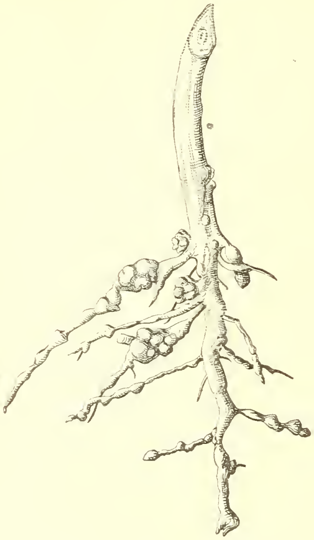

Fig. 3.—Roots of cotton, showing enlargements caused by the gallworm. Owing to the wide prevalence of this worm in the southeastern United States, the aggregate annual damage which it causes on cotton is very large, though not generally appreciated. (After George F. Atkinson.)

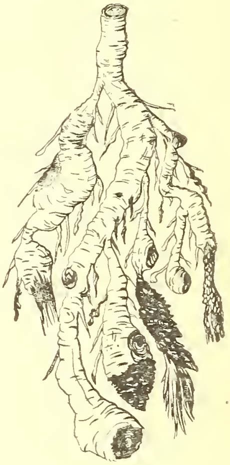

Fig. 4.—Roots of okra, showing the enlargements caused by the gallworm. The nematodes producing this disease are to be found in the root enlargements. (After J. C. Neal.)

HOW TO RECOGNIZE ROOT-KNOT.

Where root-knot occurs with wilt the injury from the latter is greatly increased. Root-knot itself does not show on the aboveground parts of the plant except through its indirect injury, and hence is frequently overlooked.

It is desirable that the farmer know with certainty whether there is root-knot in his land. As a test, okra, tomatoes, or cantaloupes may be planted and the roots dug up after midsummer and examined for swellings or galls. If these are found, a rotation of plants immune to root-knot should be started to get rid of the pest. (See p. 7.)

Root-knot causes a knotlike enlargement of the roots, varying in size from a pinhead to a hen's egg. The galls on cotton are small, on okra larger, and on cucumbers and tomatoes frequently of great size, as shown in figures 3, 4, 5, and 6. Ordinary cowpeas are

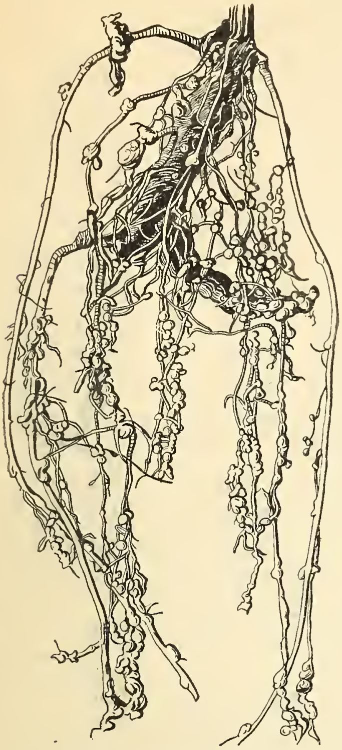

FIG. 5.—Roots of cucumber, showing enlargements caused by the gallworm. Nearly all other common garden plants are similarly attacked. There are many thousands of the worms in the nodules upon such a root system. (After Kati Marcinowski.)

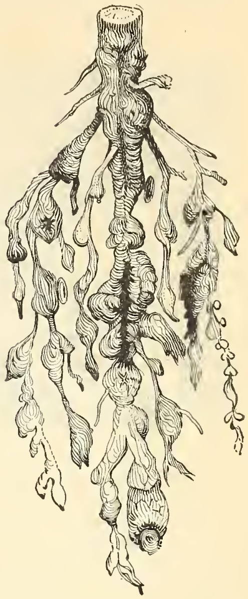

FIG. 7.—Roots of the cowpea, showing enlargements caused by the gallworm. With the exception of one variety (the Iron cowpea) this plant is very susceptible to the gallworm, and the use of susceptible varieties as green-manure crops in peach orchards and in rotations just preceding cotton in the South is to be avoided. (After J. C. Neal.)

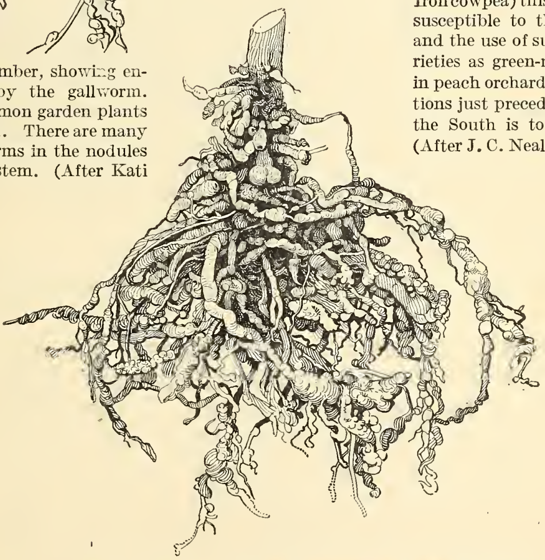

FIG. 6.—Roots of tomato, showing enlargements caused by the gallworm. Tomatoes sometimes suffer severely from this disease. (After George F. Atkinson.)

very much subject to root-knot (fig. 7), and experience has shown that when a farmer has observed that his cotton wilts worse after a cowpea crop the cause is almost always root-knot.

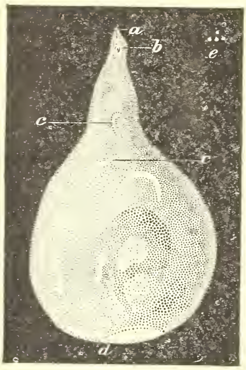

FIG. 8.—Female of the nematode gallworm (*Heterodera radicicola*) magnified 85 diameters: *a*, Mouth; *b*, spherical sucking bulb; *c*, *c*, ovaries, as seen through the body wall; *d*, anus; *e*, small white spots showing approximately the natural size of these worms. They are usually white. It is generally not difficult to isolate them in water by breaking open the galls containing them. (After N. A. Cobb.)

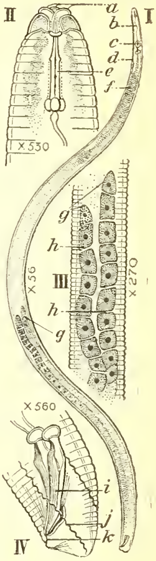

FIG. 9.—The adult male of *Heterodera radicicola*, or gallworm: *I*, Worm in profile view; *II*, head of the same, more highly magnified; *III*, middle region of the worm showing blind ends of the sexual organs; *IV*, posterior extremity. The drawings were prepared from stained specimens, examined in carbolic-acid solution.

a, Lips; *b*, œsophageal tube; *c*, median bulb; *d*, excretory pore; *e*, spear; *f*, intestine; *g*, blind ends of testicles; *h*, testicles; *i*, spicula; *j*, rudimentary bursa; *k*, anus. (After N. A. Cobb.)

For a complete discussion of root-knot, its cause and control, see Bulletin 217 of the Bureau of Plant Industry, entitled "Root-Knot and Its Control."

IMPORTANT FACTS CONCERNING WILT AND ROOT-KNOT.

Cause.—Wilt is caused by a parasitic fungus, a minute threadlike organism, which enters the roots from the soil and plugs the water-carrying vessels of the root and stem.

Root-knot is caused by minute eelworms, or nematodes, which bore into the roots. (See figs. 8 and 9.) The irritation caused by these worms results in enlarged growths of the root at the point of attack.

Plants attacked.—The cotton-wilt fungus attacks only cotton and okra. There are very similar wilt diseases of the cowpea, watermelon, tomato, and other crops, but they are not communicable to cotton.

The root-knot nematode attacks a very large number of plants and spreads freely from one to another. A few plants are immune; see list on page 7.

Duration of infection.—The wilt fungus lives many years in the soil. Rotation of crops affords only slight relief.

The root-knot nematode may be starved out by two to four year rotations of crops on which it can not live.

Fertilizers and fungicides ineffective.—Neither cotton wilt nor root-knot can be prevented by the use of kainit, salt, phosphate, or other fertilizers; nor by sulphur, lime, or other fungicides applied to the soil. Stable manure in some cases affords a degree of temporary relief from wilt.

Relation to soil.—Both wilt and root-knot are mainly confined to sandy or light loam soils. Clay soils are but seldom infected.

Means of distribution.—Wilt is spread by direct growth through the soil, by cultivation, by drainage water, by cattle, by manure, and in other ways not always explainable. No attempt to check it has ever succeeded.

Root-knot is generally brought to a farm on figs, peaches, or other plants purchased, and after its introduction it is propagated chiefly by growing ordinary cowpeas, which are quite susceptible.

Varietal resistance.—Varieties of cotton resistant to wilt have developed. The only successful method of control appears to lie along this line. Resistance to root-knot may be secured by future breeding, but at present this disease must be controlled by proper rotations.

Wilt and root-knot generally occur together. Most cases of "black-root" consist of such mixed infections and require a rotation to be practiced before resistant varieties will give their best results.

THE CONTROL OF ROOT-KNOT BY CROP ROTATION.

The principles on which rotations for the control of root-knot are based are the use of crops immune from attack and, as far as possible, those which return a profit, the building up of the fertility of the soil, and, furthermore, the eradication of all weeds subject to root-knot. Rotation and diversification of crops are of fundamental importance to southern agriculture everywhere and become absolutely necessary where the root-knot nematode is present.

The rotations necessary are of a special character, as indicated below:

CROPS IMMUNE TO ROOT-KNOT.

Barley.
Beggarweed.
Brabham cowpea.
Corn.
Crab-grass.
Iron cowpea.
Peanut.
Rye.
Velvet bean.
Wheat.
Winter oats.

CROPS SUSCEPTIBLE TO ROOT-KNOT.

Alfalfa.
Asparagus.
Beans.
Cantaloupe.
Celery.
Clover.
Cotton.
Cowpeas (all except Iron and Brabham).
Cucumbers.
Figs.
Mulberries.
Okra.
Peaches.
Soy beans.
Sugar cane.
Sweet potato.
Tobacco.
Tomatoes.
Vetch.
Watermelon.

WEEDS ATTACKED BY ROOT-KNOT AND THEREFORE TO BE ERADICATED.

Balloon vine (*Cardiospermum halicacabum* L.).
Indian potato (*Ipomoea* sp.).
Maypop or passion flower. (*Passiflora incarnata* L.).
Mayweed (*Anthemis cotula* L.).
Papaya or melon pawpaw (*Carica papaya* L.).
Pigweed (*Amaranthus hybridus* L.).
Purslane (*Portulacca oleracea* L.).
Sawbrier (*Smilax glauca*, Walt.).
Sweet fennel (*Foeniculum vulgare* Hill).

The following rotations are suggested for fields infected with both wilt and root-knot: Beginning in the fall, sow winter oats if they can be gotten in early enough to make a fairly good growth before it is necessary to plow the land for the next crop. Plow the oats under for green manure and plant corn with Iron or Brabham cowpeas between the rows, putting the corn in at the usual time, about March 15 to 20 for middle Georgia and South Carolina. In the fall sow a winter grain; this can be cut for hay the next May or allowed to ripen. Cowpeas, either the Brabham or the Iron variety, may then be sown broadcast, or, better, in 2-foot drills, where they can be cultivated once or twice. Cut the cowpeas for hay and follow with another crop of winter grain. This should be plowed under in the spring in time to plant a wilt-resistant variety of cotton the third year. If it is desired to make a 4-year instead of a 3-year rotation, the last-mentioned crop of winter grain may be harvested for hay or allowed to ripen, a second crop of Iron or Brabham cowpeas broadcasted for hay, and this followed by oats to be plowed in for green manure. A wilt-resistant variety of cotton should then be planted. Wheat, rye, or barley may be substituted for oats as a winter grain crop and velvet beans for the Iron or Brabham cowpea in the more southern districts.

THE CONTROL OF WILT BY THE USE OF RESISTANT VARIETIES.

The experiments of the Bureau of Plant Industry, which have now been carried on for 12 consecutive years, have shown that the only practicable solution of the wilt problem is through the use of resistant varieties developed by special breeding. Such varieties have been produced and grown successfully for the past six years in a large number of localities until no doubt remains as to the possibility and practicability of controlling wilt in this manner. During this time these cottons have been further improved by selection for better yield, greater resistance, higher percentage of lint, and other desirable characters.

The first wilt-resistant Upland cotton produced was the Dillon, a limbless, cluster variety derived from the old Jackson Limbless. The Dillon cotton is highly resistant to wilt and is a productive variety. It has produced a bale and a half per acre where other varieties were a complete failure. The yield of lint is from 37 to 38 per cent. This variety has been quite widely grown for several years with uniformly good results.

The second wilt-resistant variety bred was the Dixie. This has the branched pyramidal habit characteristic of the Peterkin group of varieties and is on this account more popular than the Dillon with those who object to a cluster cotton. It has medium-sized bolls and yields about 35 per cent of lint. More detailed descriptions of these varieties are given in Farmers' Bulletin 333.

A third promising variety, the Modella, also of the Peterkin type, is being introduced in Georgia by Mr. A. C. Lewis, of the Georgia State Board of Entomology.

The real problem at present is to bring these results within the reach of every farmer who needs them. The wilt exists on thousands of farms and each year is spreading very rapidly. The Government can not put into the hands of every farmer a supply of resistant seed, and, even if it could, experience has shown that this would not permanently relieve the situation, for special care is needed to prevent the resistant varieties from deteriorating through crossing with nonresistant cotton in neighboring fields, through the lack of careful selection, and through the mixing of seed at the gin. A careful man can maintain the quality of this cotton for an indefinite period, but when neglected it has to be replaced by fresh seed in three or four years. Consequently there is likely to be a permanent annual demand for some thousands of bushels of carefully bred wilt-resistant seed in every county. It is furthermore apparent that this should be supplied from within the home county, for locally bred seed is adapted to local conditions and gives better results than seed brought from a distance. An excellent opportunity exists for progressive men to engage with profit in the growing of this seed. The methods found most successful in this work require accuracy and care and instruction at the start. There is also need for educational work among the farmers that they may understand the methods of wilt control and the need for root-knot rotations in connection with the use of resistant varieties.

THE ORGANIZATION OF A COOPERATIVE CAMPAIGN.

The needs mentioned have led to the development of a cooperative arrangement between the three organizations that have been charged with one phase or another of the work, namely, the Office of Cotton and Truck Disease and the Office of Farmers' Cooperative Demonstration Work in the Bureau of Plant Industry and their respective State agencies, the agricultural experiment station at Clemson College for South Carolina, and the State Board of Entomology at Atlanta for Georgia.

Since the plan seeks to utilize all existing agencies and to put the great problem of wilt control on a self-supporting basis, the details will be of interest to all concerned. The Office of Cotton and Truck Disease has been engaged in the scientific questions involved—the study of the nature and cause of wilt, its control, the breeding of resistant varieties, the nature of disease resistance, etc. The pathological problems have been nearly solved. This office is now working on the relationship and parasitism of the wilt fungi. The breeding problems are also well on the way to solution. There remain to be completed studies on the inheritance of disease resistance and a new line of breeding made necessary by the eastward migration of the boll weevil, namely, the production of wilt-resistant varieties that are early, large bolled, and adapted to boll-weevil conditions. This work has been under way for four years. It has given results of promise and will be carried on to completion.

The part of this office in the cooperative work will be to outline methods of control, provide stocks of the resistant varieties bred, and furnish all needed aid and information to the other workers. The work will be done through its representatives in the field who are at the same time the employees of the South Carolina Agricultural Experiment Station and the Georgia State Board of Entomology. The work in Washington is in charge of Mr. W. A. Orton, assisted by Mr. W. W. Gilbert. The office is represented in South Carolina by Prof. H. W. Barre, of Clemson College, assisted by Mr. L. O. Watson, and in Georgia by Mr. E. L. Worsham and Mr. A. C. Lewis, of the State Board of Entomology at Atlanta.

The Farmers' Cooperative Demonstration Work, in charge of Mr. Bradford Knapp, has for its general object the improvement of agricultural methods and conditions in the regions invaded or about to be invaded by the boll weevil. It has built up for this purpose a large organization, reaching from State agents through county and local agents to thousands of farmers who are trying new methods. It is through these agents and demonstrators and through the extension department of the States that the men on the farm can be helped most directly. The part taken by this office in the cooperation consists in the dissemination of information, in bringing effective rotations for the control of root-knot into general practice through demonstrations by farmers, and in the introduction and trial of wilt-resistant varieties of cotton and cowpeas.

The agents of the Farmers' Cooperative Demonstration Work will meet the pathologists as frequently as possible and secure their help in identifying plant diseases and their advice regarding methods of control.

The officers of the experiment station in South Carolina and the Board of Entomology in Georgia cooperate in this campaign in several ways. Their pathologists are the official representatives of the Bureau of Plant Industry to the end that the efforts of all workers may be united and duplication of effort and expense avoided.

Two distinct lines of work are under way. The first is the dissemination of information on wilt and root-knot and their control. The second seeks to provide for the local production of an adequate supply of the resistant varieties of both cotton and cowpeas, the permanent maintenance of their quality, and the production of still better strains. This is to be accomplished by cooperation with progressive farmers in the wilt-infected territory.

THE COOPERATIVE BREEDING PLAN.

Experience has shown that most farmers lack the time or opportunity to do careful seed breeding and that consequently there is a large and steady demand for improved seed. It will be especially so with the resistant varieties, and it is believed that the production of such seed will constitute a specialized business in which a limited number of farmers will find it profitable to engage.

To assist in the development of such a line of work, and to insure the production of a supply of high-bred wilt-resistant seed of known origin, a plan of cooperation between the United States Department of Agriculture, the State agricultural officials, and the farmers who desire to make a specialty of such breeding work has been formulated and 20 or 30 men in each State (Georgia and South Carolina) have already become interested in the work. The farmers sign agreements with the Department and State representatives, promising to secure proper seed, to follow the breeding methods outlined, to exercise the necessary care to maintain the purity of their seed, and to offer it for sale at a reasonable price, not to exceed an amount previously agreed upon. They also agree that they will not sell seed not grown by them unless so stated. The Department and State representatives provide the cooperative breeders with small quantities of select planting seed or refer them to farmers from whom select seed can be purchased at a reasonable price, not to exceed $1.50 a bushel. They visit the breeders during the season to advise them regarding the best methods of breeding and to inspect their crops.

Two grades of selected seed will be recognized: "Registered seed" and "improved seed." Such men as attain the highest standard in their breeding by carefully following the individual-selection and progeny-row methods recommended and whose seed is of high grade will be granted a diploma and allowed to sell their crop as "registered seed." Other breeders who are found to be maintaining the standard of their varieties in wilt resistance, yield, and purity, but who are not yet following the required breeding methods in detail or doing progressive breeding will be given a certificate of recognition of quality and their seed will be designated "improved seed." These diplomas and certificates will be given only after thorough inspection of the growing crops by experts and after an official test of the seed placed on sale by the breeder in comparison with standard resistant strains.

HOW TO SECURE INFORMATION.

The farmer who has had trouble with wilt or root-knot may secure help from the nearest agent of the Farmers' Cooperative Demonstration Work or by addressing Prof. H. W. Barre, Clemson College, S. C., or Mr. A. C. Lewis, Capitol Building, Atlanta, Ga., who will advise him with regard to the diseases and the best methods of control·

HOW TO SECURE RESISTANT SEED.

As a result of the cooperative breeding work that has been carried on during the past season, a considerable supply of wilt-resistant cotton seed of the Dixie and Dillon varieties has been produced by cooperating farmers under the supervision of our representatives in Georgia and South Carolina. This seed is now for sale by them at a price not to exceed $1.50 a bushel. Parties desiring to secure any of this seed for planting should write immediately to Prof. Barre or to Mr. Lewis, stating how much seed is desired. An order on the cooperative breeder nearest them for the desired quantity of seed will then be sent them, together with the price to be paid. This order, accompanied by the necessary money, must be sent by the purchasing farmer to the breeder, who will immediately ship the seed. Shipment by freight or express should be specified, all charges to be paid by the purchaser.

THE PRINCIPLES OF BREEDING.

To maintain the quality of an established cotton variety it has generally been believed that it is only necessary to grow the cotton in a field as far separated from other cotton fields as circumstances permit, to pull out all plants of undesirable character (the process of "roguing" in the language of seed growers), and to exercise care at the gin to avoid mixture with other cotton. All this is indeed imperative, but it has been found that one step farther is necessary to accomplish the best results and that step is to practice the progeny-row method of breeding.

This method depends on the simple fact that plants differ not only in their visible characters but also in their ability to transmit these characters to their offspring. Cotton should be very uniform in length and quality, but the greatest variation exists in an unselected field. Some plants taken from each field produce variable offspring, while others produce uniform offspring, give a larger yield, a higher lint percentage, and a better staple.

BREEDING METHODS.

The progeny-row method consists in the selection of the best plants to be found, in planting the seed from each in a separate row, and in the final choice that autumn of the best row or rows, the seed from which is increased as rapidly as possible the following years. The details of this method as now practiced and recommended for the breeder are as follows:

Preparation of land.—Assuming that, to start his breeding work, the prospective breeder has obtained from the Department of Agriculture or elsewhere a few individual plant selections made the previous year, he should first select a piece of land badly infected with wilt, separated as far as possible from any other cotton field to avoid cross-pollination; often a plat may conveniently be located in a cornfield or in a field of the same variety being grown for seed. Care should be taken that the land is not infected with root-knot. The plat should be prepared and fertilized as for other cotton and the rows laid off in a block, side by side (see figs. 10, 11, and 12), 4 to 4½ feet apart and 200 to 250 feet long, thus providing for 100 hills 2 to 2½ feet apart in each progeny row. Plenty of space is necessary to permit the normal development of the individual plants.

Diagrams illustrating methods of seed selection.

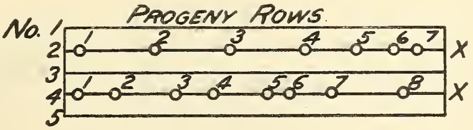

FIG. 10.—(*First Year.*) Five selections, made from individual plants of the Dixie variety, are planted in 100 hill rows. This plat is isolated or placed in a cornfield or in a field of Dixie cotton to prevent crossing with other cotton. All wilted and inferior plants are pulled out during the season. At the end of the season the rows are carefully inspected, Nos. 2 and 4 selected as the most wilt resistant and productive, and Nos. 1, 3, and 5 discarded. From these selected progeny rows, indicated by "x," 15 individual selections are made, indicated by circles and numbers. These are ginned and 8 discarded because of too low lint percentage or other undesirable characters, leaving the 7 best plants for use next season. All the remaining plants in the 2 selected progeny rows are picked into 2 lots for planting increase plats the following year.

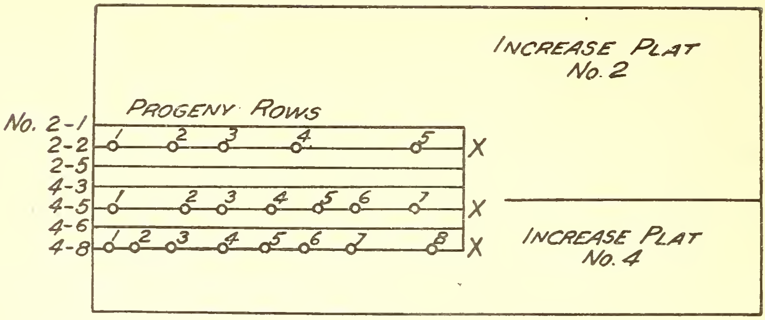

FIG. 11.—(*Second Year.*) Two increase plats, Nos. 2 and 4, are planted from seed saved the first year. The 7 individual selections are planted in a block surrounded by the increased plats, as indicated. The roguing of the increase plats and progeny rows is done the same as the first year. After careful inspection in the fall, 3 progeny rows are selected (indicated by "x"), and from these, 20 individual selections are made, as indicated. The remainder of the selected progeny rows are picked by themselves, ginned, and compared for wilt resistance, yield, and lint percentage, with the result that 2 are saved for the next year's increase plats, namely Nos. 2-2 and 4-8. In the same manner the 20 individual selections are ginned and compared, and 10 finally saved for further work.

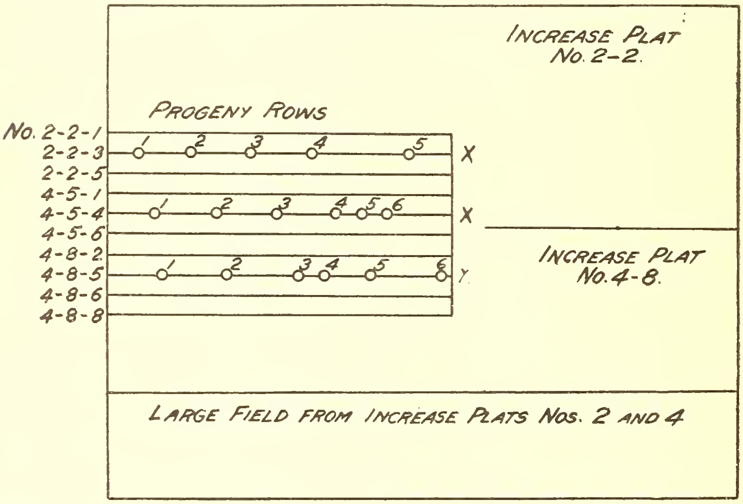

FIG. 12.—(*Third Year.*) The seed from progeny rows Nos. 2-2 and 4-8 of the second year are planted in 2 increased plats and at one end of these, as indicated, are planted the 10 individual selections finally saved. The seed from the 2 increase plats is used to plant a large adjacent field for seed purposes. These seed are designated "registered seed." The same methods of roguing and individual selection are continued in this and subsequent years.

Planting.—The individual selections should be planted by hand in these progeny rows. A small bull-tongue or wooden V attached to a plowstock may be used to open a shallow trench in the beds. The seeds are dropped in this trench at the proper intervals and covered about an inch deep with the foot and the soil is very slightly compacted. Four or five seeds to the hill should be used and the remainder saved for possible replanting. Each row should be marked by a stake at the end, bearing the number of the individual selection. This should be driven down so that the whiffletrees will not hit it during cultivation. Stakes should be at least ½ by 2½ by 18 inches long and planed on one side so that the numbers can be written on them with a heavy pencil. For convenience in field labeling and in keeping breeding records, each selection grown by an individual farmer is given a number, as 1, 2, etc.; and each individual selection made from these has another number added to the first with a dash between, as 2–1, 2–2.

Thinning, wilt counts, and roguing.—All progeny rows should be gone over about the middle or last of May, the exact time depending on the date of planting, and all hills thinned to one plant, leaving the healthiest plants. A record of the number of hills should be made to form a basis for the determination of wilt resistance. Counts of the wilted plants in each row should be made about June 20, August 1, and September 15. The total number of wilted plants compared with the figures of the original stand will give the percentage of wilted plants. Wilt resistance should be the first and most important consideration in the selection of the best progeny rows, only those being taken which are highly resistant. After each wilt count the diseased plants should be pulled or rogued out to prevent their crossing on other plants or being picked by mistake with the healthy plants.

The year following, when an increase plat is grown from the progeny-row seed, a similar method of roguing, involving the pulling out of all wilted and nontypical plants, is practiced to maintain the purity and wilt resistance of the strain.

Selection and note taking.—After the last wilt counts in September have been made, the progeny plat should be gone over carefully and all rows discarded that show much wilt. Records should be made of the principal characters of the progeny rows, such as earliness, uniformity, size, etc., on note blanks provided by the Department of Agriculture. In the books in which these blanks are bound, detailed directions for taking notes are printed and the time required for the work is very largely reduced by the use of a series of symbols to indicate the degrees of the characters present which are listed on the note blanks.

Note blank prepared by the Department of Agriculture.

COTTON NOTES.

No.................................... Year..................

Locality.............................. Farm of.............................. Notes by..................

PROGENY NOTES.	No. off Type....................	GENERAL NOTES.
—	Earliness....................	—
Date Planted....................	Uniformity....................	....
No. Hills....................	Productiveness....................	....
Germination....................	Shedding....................	....
Date Replanted....................	Height....................	....
No. Living....................	Shape....................	....
No. Wilted....................	No. Selections....................	....

INDIVIDUAL NOTES.	1	2	3	4	5
Earliness					
Productiveness					
Shedding					
Shape					
Height					
Joints—long or short					
Basil branches—number					
Length					
Productiveness					
Leaves—Size					
Persistence					
Bolls—No					
Shape					
No. mature on					
No. locks					
Weight seed cotton in .... bolls					
Ease of picking					
Seed—Size (weight per hundred)					
Color					
Fuzz					
Lint—Length					
Strength					
Lint index					
Per cent lint					

After what appear to be the best progeny rows have been picked out, a number of the best individual plants should be selected from them.

The person who does the selecting should have in mind a clear picture of the type toward which he wishes to select and take only those plants that conform as closely as possible to that type. This is an all-important point, since if the type selected for each year is different progress is impossible. Only by continuous selection toward a certain ideal type can that type be attained or even approximated.

For convenience in finding the plants for picking, a white or light-colored piece of cloth should be tied to the top of the selections. A tag should also be attached, bearing the number of the progeny row plus the number of the individual selection made from that row, as 2–2 or 4–3–1. Selections should be made at the time of the first picking, which is best delayed until at least half the cotton is open, as one can more easily judge of the plant's performance at that time than earlier. After the necessary notes have been taken on the note blanks provided, the individual selections should be picked separately into cloth bags or strong paper bags and plainly marked with the number of the plant. The rows should then be picked, a record being made of the exact number of plants picked in each row. The second picking should be made when most of the cotton has opened, but before frost has caused the premature opening of late bolls. For comparing the yields the cotton from all the progeny rows, including the first and second pickings, should be weighed separately and the yield per hundred plants calculated.

Ginning.—The ginning of the individual selections and progeny rows should be left until winter, when the rush of fall work is over.

For ginning individual plants a small hand gin is essential. Three types of hand gins are on the market: (1) A small saw gin, very similar in appearance to the ordinary commercial saw gin, but having only 10 saws and furnished with a handle by means of which it is operated; (2) a small-sized roller gin of the type generally used to gin Sea Island cotton and also operated by a handle; and (3) a gin somewhat similar to the roller gin but having a series of fingers instead of beaters to break the lint from the seed. The price of these gins is from $50 to $75. It is often possible for several farmers to club together to bear the expense of such an outfit. Progeny rows, as well as individual plants, can best be ginned on a hand gin. In ginning different individual plants or progeny rows, great care should be exercised that the gin be thoroughly cleaned out after each operation, so that not a single seed will be left to mix with the succeeding lots or to render the results of both lots less accurate.

Lint percentage.—Before being ginned the seed cotton of each plant should be carefully weighed on a pair of scales that will weigh in grams. Before weighing the cotton all burrs or trash should be picked out and any sand present knocked out by beating the cotton over a wire screen. After ginning, the seed should be weighed and the weight of lint determined by the difference between the weight of the seed and the seed cotton. The weight of the lint divided by the weight of the seed cotton equals the percentage of lint. In the final selection of the best individuals for future breeding, preference should be given to those having a high lint percentage, other things being equal, and selections having less than 35 per cent of lint should be discarded.

Length of lint.—The length of the lint of individual selections should be roughly noted in the field when selections are made and no plants with a distinctly short lint should be saved. If more accurate data are desired they can be obtained by a more careful study of the cotton at the time of ginning. The best way is to comb out the lint on a few seeds with a very fine comb and measure with a ruler. Selections having a staple less than three-fourths to seven-eighths of an inch should not be saved.

Lint index.—"Lint index" is a term used to designate the quantity of lint on 100 seeds and is held by some[1] to be a more accurate method of estimating the value of a strain of cotton than the lint percentage. It is obtained by multiplying the weight of 100 seeds by the percentage of lint previously determined and dividing by the percentage of seed, viz, 100 minus the percentage of lint.

Size of seed.—If the size of seed of different selections is desired for comparison, the weight in grams of 100 seeds is determined. These data are necessary if the lint index is to be calculated.

Increase plats.—When the progeny rows that were saved have been weighed, ginned, and the lint percentage determined, the one or more that are to be used for the increase plats the next season for the production of planting seed should be selected, choosing the ones that have the greatest wilt resistance, the largest yield per hundred plants, and the highest lint percentage. These seeds should be planted on wilt-infected land in the same field with the smaller plats. (See figs. 10, 11, and 12.) If the quantity of seed is small it may be made to go farther by careful hand planting. Enough seed should be reserved with which to replant if necessary, and under no circumstances should seed of another variety be used for replanting. Any missing hills may well be planted to cowpeas for seed purposes. The field should be thinned, so as to allow plenty of space for the proper development of each plant. During the season the field should be gone over several times and all wilted or nontypical plants pulled out. This is extremely important, as only by removing the inferior plants can crossing with them be prevented and deterioration of the cotton thereby avoided. The cotton should be carefully picked by itself and every precaution taken to prevent mixing with any other cotton.

For ginning it is best to wait until late in the season, when the rush is over. It is then possible to have the work done more carefully, as more time is available. If possible, a farmer who runs a single gin should do the ginning. The roll should be taken out of the gin and every seed of other cotton removed from any place where it is liable to become mixed with that to be ginned. If taken to a public gin the cotton should not be run through the cotton feeding device or the seed through the screw seed ejector. The gin should be fed by hand and the seed caught on the floor or on a piece of burlap spread down for the purpose.

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[1] Cook, O. F. Danger in Judging Cotton Varieties by Lint Percentages. Circular 11, Bureau of Plant Industry. 1908.

This selected seed is to be used in planting a larger area the succeeding year for seed purposes. (See figs. 10, 11, and 12.) This seed field should be given the same care as the increase plat. Careful personal supervision of the details of this work is essential to the maintenance of the best grade of seed.

Approved:
James Wilson,
Secretary of Agriculture.

Washington, D. C., *February 23, 1912.*

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